Medical Data Recording System

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Background of the Invention

Field of the Invention

This invention relates to data storage and more particularly to determining end of incoming data stream in order to create jobs for recording and printing file information on a disc taken from the electronically stored information on the disc.

Description of the Related Art

In the past medical imaging such as x-rays were recorded on film and digital images were stored on digital film using film laser printers, which is expensive, bulky and difficult to store. Also, the original digital data might have to be modified so it can be printed using a laser printer since most printers can not handle high resolution or high quality digital data. Digital image storage allows storage and retrieval of original digital data on discs and transmittal of images over communications systems such as the internet.

There are printers combined with CD recording devices for printing on the disc that has just been recorded.

Medical imaging data is frequently manually stored on CD's and filed for later use in doctor's offices, hospitals, clinics and other medical facilities. The medical images may be generated by x-rays, cat scans, magnetic resonance images, sonograms or other image generating technologies.

Medical imaging data can be transmitted from one location to another over the internet or other communication system for recording the data. The filing and record keeping of the images thus received is a problem. It is a labor-intensive and error-prone

1   task to gather information about each disc, write out labels and attach the labels to the

2   discs, or write directly on the disc for storing and filing. It is very useful to have the

3   information contained on a disc printed on the disc for reference and filing and for

4   automatically creating a directory of the information stored on all the discs recorded in an
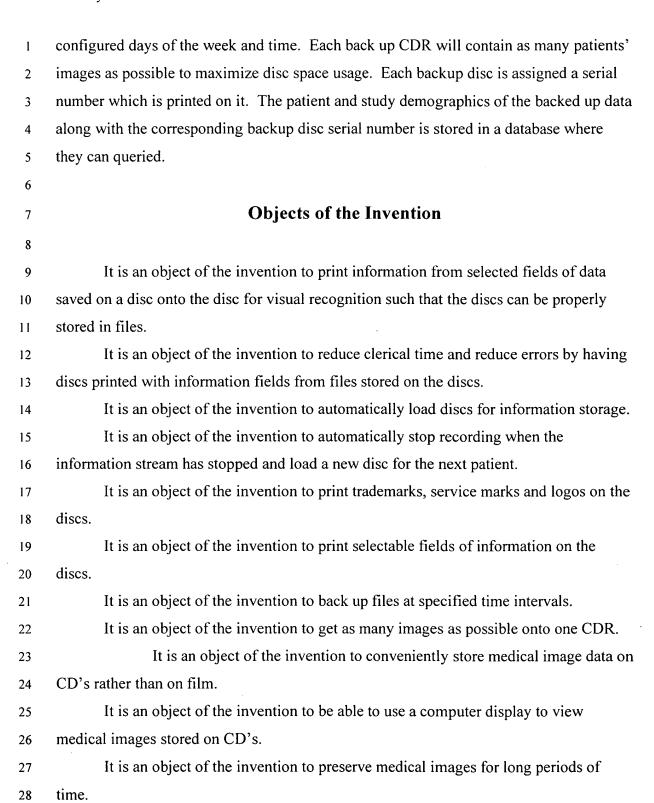
5   office.

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Summary of the Invention

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9   The present invention automatically scans data received for storage on the disc

10   and prints selected fields of information directly on the discs for ease of file management.

11   The invention also constantly updates a database having a directory of all patient records

12   and the discs the patient data is stored on. Although the invention is described in terms of

13   storing medical imaging data any data imbedded with information useful for filing and

14   label printing can be used with the invention.

15   The Medical Data Recording System hardware consists of three main

16   components: a computer server; a CD autoloader with printer; and a piracy prevention

17   device. The software components are: DICOM® communication software; FilmX^{TM}

18   software for storing software for viewing the images on the CDs, software for selecting

19   image information to be copied to the CD and fields for printing on the discs; software

20   for creating and updating a database of patient information and autoloader control

21   software for the CDR and printer; and security device driver software.

22   The computer server communicates with other medical devices on the network

23   using the DICOM® protocol. It receives medical images (patient studies) from other

24   devices, processes the images and burns each patient's images on one or more CDRs

25   along with medical image viewing software and other files as defined by the DICOM®

26   protocol as well as files containing printed label definition and graphics files, files

27   containing patient and study demographics, and necessary system files to make the CD

28   autorun and autoload. Once a CDR has been burnt, information regarding the contents of

29   the CDR and other graphics (company logo, legal notices, etc) is then printed directly on

30   the CDR using the printer attached to the autoloader. Optionally, the system will create

31   back up copies of the medical images it has received by burning them on CDR at

1 configured days of the week and time. Each back up CDR will contain as many patients'

2 images as possible to maximize disc space usage. Each backup disc is assigned a serial

3 number which is printed on it. The patient and study demographics of the backed up data

4 along with the corresponding backup disc serial number is stored in a database where

5 they can queried.

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7 ## Objects of the Invention

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9 It is an object of the invention to print information from selected fields of data

10 saved on a disc onto the disc for visual recognition such that the discs can be properly

11 stored in files.

12 It is an object of the invention to reduce clerical time and reduce errors by having

13 discs printed with information fields from files stored on the discs.

14 It is an object of the invention to automatically load discs for information storage.

15 It is an object of the invention to automatically stop recording when the

16 information stream has stopped and load a new disc for the next patient.

17 It is an object of the invention to print trademarks, service marks and logos on the

18 discs.

19 It is an object of the invention to print selectable fields of information on the

20 discs.

21 It is an object of the invention to back up files at specified time intervals.

22 It is an object of the invention to get as many images as possible onto one CDR.

23 It is an object of the invention to conveniently store medical image data on

24 CD's rather than on film.

25 It is an object of the invention to be able to use a computer display to view

26 medical images stored on CD's.

27 It is an object of the invention to preserve medical images for long periods of

28 time.

29 It is an object of the invention to create patient files with directories and

30 subdirectories from image data streams.

31 It is an object of the invention to divide data streams into separate files.

1   It is an object of the invention to automatically create and update file databases to

2   locate patient information on the discs.

3   Other objects, advantages and novel features of the present invention will become

4   apparent from the following detailed description of the invention when considered in

5   conjunction with the accompanying drawing.

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7   **Brief Description of the Drawings**

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9   Fig. 1 shows a schematic of the system using the data recording system.

10   Fig. 2 shows a block diagram of the software steps used in the computer for receiving

11   files from the network and storing them on the computer.

12   Fig. 3 shows the routine for determining the data for jobs from incoming files.

13   Fig. 4 shows the routine for processing jobs in queue.

14   Fig. 5 shows the routine for checking for end of jobs.

15   Fig. 6 shows the routine for the backup process.

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17   **Description of the Preferred Embodiments**

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19   Figure 1 shows a schematic view of the invention. A medical imaging device 10

20   such as an x-ray, cat scan, magnetic resonance imaging, sonogram or other device which

21   generates information for storage on a disc generates images of a patient and either

22   transmits it or stores it for later transmittal through a communication network 20 such as

23   the internet to a computer 30. The computer 30 can be used to select information to be

24   stored by the compact disc writer 40 on compact discs, CDs, 42 and can select what

25   information is to be printed by printer 44 on discs 42. Although CDs 42 are shown, any

26   recording medium may be used for storage of information. The blank compact discs 42

27   are stacked in an input CD stack 43 waiting to be recorded. The CD autoloader 46 selects

28   CDs 42 from the top of the input CD stack 43 to be recorded on and places the CDs 42

29   into the recorder 40. When the CD 42 has information stored on it, it is moved by the CD

30   autoloader 46 to the printer 44 where selected information and logos or other graphics are

31   printed on the CD 42 so that the users have a written record on the disc of the information

1   stored thereon and logos identifying the producer of the disc or other information. The

2   CDs 42 are then removed from the printer 44 by CD autoloader 46 and placed in the CD

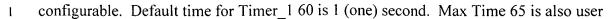3   output tray 45. The CDs 42 can then be placed in patient files.

4   The software for running the invention performs several tasks. There is security

5   software communicating to an attached piracy prevention security device that keeps track

6   of how many CDs are being recorded and what product option are active. There is

7   software to run the autoloading functions of the CD autoloader 46 for recording and

8   moving discs 42. The software also can be programmed to select the fields of information

9   to be printed on the discs and for printing logos or other graphics or information on the

10 discs. The software also copies instructions for operating the imaging onto the disc so

11 that a computer without imaging software loaded in it can view the images on the discs.

12   Although many different software programs can be used to accomplish the goals

13 set out above the following shows one method of securing image information for later

14 viewing and recording it on discs with labels printed thereon. The software described

15 herein is called FilmX™ software by the applicant.

16   FilmX™ software is used to receive data in the computer 30 from the

17 communication network 20. The software incorporates DICOM® network connectivity

18 software 51 such as WinSCP32.exe which is currently a standard digital imaging protocol

19 used in the industry to receive the digital imaging data from the imaging device 10. The

20 imaging data is received in the computer 30 by use of network connectivity software 51

21 using "winSCP32.exe" software available from ETIAM Corporation; Rennes, France.

22 This program is a Storage Service Class Provider using the DICOM® protocol. The

23 computer 30 receives DICOM images that are sent to it and places them in the Incoming

24 ("D:\Incoming") directory 52. The files are named:<Storage SOP Class>.<SOP Instance

25 UID>.dcm where <Storage SOP Class> is the SOP class of the image and <SOP Instance

26 UID> is the image UID (Unique Identifier).

27   There are multiple timers defined with in FilmX.exe. Timer_1 60 is responsible

28 for checking for incoming new files 61 in Incoming Directory 52. If new files are

29 received they are stored as a separate file in a temporary directory Temp Directory 63.

30 Timer_1 60 is programmed to check if an end-of-patient-data timeout (MaxTime) 65 has

31 occurred. The value for Timer_1 60 is defined in the FilmX.ini file and is hence user

1   configurable. Default time for Timer_1 60 is 1 (one) second. Max Time 65 is also user

2   configurable via FilmX.ini and is set to 30 seconds for default. The system will not allow

3   that time to be set less than 10 seconds. Once the Timer_1 60 goes off, two routines are

4   called:

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6   DcmBTreeParseInputDirectory

7   dcmBTreeMakePatientDataAvailable

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9   The first routine parses any DICOM Part 10 file found in Incoming Directory 52.

10 If any new files 61 are available, they are transferred to the Temp Directory (d:\Temp)

11 63. For each different patient, a subdirectory is created under the Temp Directory 63, and

12 for each study of this patient, a subdirectory is created under the patient directory.

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14   Patient differentiation is based on Patient Identification which consists of the

15 concatenation of information found in DICOM datasets: PatientsID '_' PatientsName,

16 without any '^', any white character or any character that may lead to an invalid Windows

17 directory name, all characters are uppercase and enclosing blanks are removed.

18 Patient Directory name underneath Temp Directory 63 is the Patient Identification

19 described above.

20   Study identification is based on the StudyInstanceUID. Study Directory name

21 beneath the Patient Directory is the study identification referenced above.

22   Filenames are the original filenames found in Incoming Directory 52. This allows

23 the system to override an image if it is sent twice.

24   An additional text file is created in each Patient Directory. This file has a fixed

25 name (timestamp.bsy) and contains the date and time of the last image insertion in the

26 Patient hierarchy. The following information is also written in this file:

27 • PatientsName

28 • PatientsSex

29 • PatientsBirthDate

1   An additional text file is created in each Study Directory. This file has a fixed

2   name (study.dsc) and contains the information extracted from the last image of the study

3   inserted in the Study Directory. This information is as follows:

4   • StudyDate

5   • StudyTime

6   • StudyID

7   • StudyDescription

8   • RefferringPhysiciansName

9   • AccessionNumber.

10

11   Once DcmBTreeParseInputDirectory has returned, any new patients are added to

12   the Incoming Patient Queue and displayed on the screen as such. The combination of

13   patient "[id]_[name]" is now the internal job name used for tracking the job.

14   Then dcmBTreeMakePatientDataAvailable is called to check in Temp Directory

15   63 if any patient subdirectories have not been modified (some images added) since

16   MaxTime 65 seconds ago. The number of unmodified directories since MaxTime 65

17   seconds is returned. If no new files 61 have arrived for a patient, the timestamp file

18   (timestamp.bsy) for the patient will be renamed to a fixed filename (timestamp.rdy).

19   Once the function returns a positive number, we browse for Patient Directories in

20   the Temp Directory 63 containing "timestamp.rdy" file. The entire patient hierarchy is

21   then moved to the Backup Directory 71 (D:\Backup). The Job is then removed from the

22   Incoming Patient Queue and added to the Pending Patient Queue and displayed as such.

23   If inactive, Timer_2 70 is activated to start processing the pending job(s).

24   Timer_2 70 is responsible for moving jobs pending in Queue to be processed.

25   Once it goes off, the system is checked for any patient in queue 72, if none are present,

26   Timer_2 70 is disabled in step 74. If there are pending jobs in Pending Patient Queue,

27   the system is checked for patient in process 73 (being recorded or printed). If there is

28   one, Timer_2 70 is disabled and it returns. If there are no patients in process 73, the next

29   job in Pending Patient Queue, is processed. The patient directory hierarchy in Backup

30   Directory 71 is moved to the Build Image Directory 75 (D:\Build Image) to get ready to

31   burn on CDR(s). The Build Image Directory 75 also contains a Viewer Directory

1   ("\Viewer) where the viewing software resides. There is also a FilmX Directory

2   ("FilmX") in the Build Image Directory 75 which contains the Patient information file

3   ("Patient.txt") and the Xlabel Directory ("\Xlabel") where the CD printing label

4   definitions and graphics files reside. Since DICOM Exchange standards only allow for

5   eight character file names, the Patient, and Study directories as well as image file names

6   are converted to eight character format in processing step 76. The Patient Directory

7   name is changed to "PT000000" for the first patient. In case of back up CD, Patient

8   Directories are then sequentially named "PT000001" and so on. The Study

9   Directory(ies) are named starting with "ST000000" and increase sequentially if there is

10   more then one study for the patient. The image files are then named starting with

11   "IM000000" and so on. On the Build Image Directory 75 there is also an "autorun" file

12   which is recognized by the Windows operating system and executed when a disc is

13   inserted in a computer. The "autorun" file contains instructions to start the viewer in an

14   "autoload" fashion causing it to immediately load and display the first Patient's first

15   Study. Finally, according to DICOM Exchange standard, a "DICOMDIR" file in

16   generated in step 76 in the Build Image Directory 75.

17   Once the Build Image Directory 75 is complete, it represents what should be put

18   on the final CDR with Build Image Directory 75 as the root of the CD. The computer

19   program "Premaster.exe" is then called to create a CD image of the contents of the Build

20   Image Directory 75. This program is part of the BuzzSaw® software package produced

21   by ISO Media of Seattle, Washington. The result is a "[job].CDR" file which is the

22   image of the final CDR. It is located in the Spool Directory 77 (E:\Spool). A "[job].job"

23   file containing the job control information for the autoloader control software

24   (Buzzsaw®) is created in the Spool Directory 77. The Job file specifies the name of the

25   CDR file, the input file for the print label fields, the number of CDRs to be made, the test

26   flag, and other fields as required by the Buzzsaw® software. Once the CD image files is

27   generated in the Spool Directory 77, the Build Image Directory 75 is then cleared of the

28   patient directory and other created files. Once created, the job file is recognized by the

29   Buzzsaw software and processed.

30   Buzzsaw® instructs the autoloader 46 to pick up a new CDR 42, put it in the

31   CDR drive 40. Once there, Buzzsaw® will proceed to record the contents of

1 "[job].CDR" file on the CDR 42 in the drive 40. In multi-copy, multi-drive situations,

2 Buzzsaw® will place new CDRs 42 in other drives 40 as well and record them

3 simultaneously. Once the recording is finished, Buzzsaw instructs the autoloader 46 to

4 place the recorded CDR 42 in the Disc Printer 44. It will then execute the printing

5 software to print the label containing the input fields on the CDR.

6   The label printing software and printer driver are supplied by Primera

7 Technologies; Plymouth, Minnesota, a disc printer manufacturer. The label definitions

8 allow for input fields to be merged into the label via a merge file in Build Image

9 Directory 75. The patient.txt file in the Build Image directory 75 is that merge file.

10   Once printed, the CDR 42 is then placed in the output bin 45 by the autoloader 46.

11 If there are multiple copies, the other CDRs 42 are then printed by the Disc Printer 44 and

12 put on the output bin 45 as well by the autoloader 46. Buzzsaw then updates the status

13 line at the bottom of the "[job].JOB" file contained in the Spool Directory 77 to indicate

14 the job is completed.

15   Timer_3 80 is responsible for checking the end of the job. Once Timer_3 80 goes

16 off, the system checks for job done 81. If so, the job is moved from the Patients in

17 Process to Patients completed and display is updated in step 82 where Timer_3 80 is

18 cleared, and Timer_2 70 is enabled. If Backup Enabled 83 is false, the patient directory

19 is deleted from Backup Directory 71. Otherwise, it will be kept there to be used during

20 the backup.

21   Timer_4 90 starts the backup process. It is programmed to go off at the

22 configured time on the configured day(s) of the week. The program then checks if there

23 are any files to backup 91. This is also a check for the end of back up process. If

24 finished (or nothing left to back up), a CDR 42 containing only the latest database files is

25 generated 99. This is the backup disc for the database files. If there are files to backup

26 91, in Select Patients step 92 enough patients are selected to fill a 650 MB CD (if there

27 are enough) minus approximately 10 MB which is used for storing system, label, and

28 viewer files. A Backup CD unique serial number is also generated in Select Patients step

29 92. The patient directories are then moved from Backup Directory 71 to Build Image

30 Directory 75. The same processing as for a patient CD, as described in steps 75 – 77

31 above then occur steps 93 – 95. Once a backup job is created, the software then goes